

RF



ORANGE COUNTY AMATEUR RADIO CLUB, INC.

VOL. LV NO. 11

P.O. BOX 3454, TUSTIN, CA 92781-3454

November 2014

The Prez Sez.....

by Nicholas AF6CF



Hello and Greetings to all!

November is here, so we are in the Club's Elections month, and gearing up for the Holiday Banquet on December 12th. But first, let me report that the October Auction was a big success, with lots of fine equipment changing hands and the Club benefiting from all the action. Many thanks to the generous souls that donated equipment to be sold, and especially to the Chief Auctioneer Chip K7JA who, as usual, did a fantastic job in a very good time frame.

We have an outstanding speaker for the November meeting,

after that we will have the elections for next year's Board of Directors. The presentation will be the about History of Radio part two, and we will learn about the equipment of yesteryear until the modern days. The elections committee is feverishly working on a slate, but as per the Club's rules, anybody can be nominated to any position from the floor, so this is your chance to help the Club run its daily business by becoming one of the Directors (or even President), Any current Club member can have any position on the board. As mentioned, the Christmas Party date has been set for Friday December 12th. Mark your calendars early so you don't miss it. The cover price will be a few dollars less than previous years, and we will have great door prizes, including gift certificates, radios, antennas, etc. Please see this newsletter for location and times. As usual, I look forward to an eyeball contact with you all at the next General Meeting, and expect you to cast your vote for next year's Board of Directors. Remember, "Vox Populi, Vox Dei".

73 DE AF6CF

Next Meeting

The next [General Meeting](#) of the OCARC will be held on Friday, November 21th, 2014.

Dennis Kidder - W6DQ will present talk on:

"The History of the Development of the Modern Communications Receiver — Part II",

covering the WWII years to the present - and beyond! Dennis presented Part I of this series at our April meeting.

The next general meeting will be on:

**Friday, November 21th, 2014
@ 7:00 PM**

As usual, we will be meeting in the east Red Cross Building, Room 208. See you there!

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**ORANGE COUNTY
AMATEUR RADIO CLUB**
www.W6ZE.org



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**OCCARO
is currently INACTIVE**

Contact the Newsletter:

Feedback & Corrections:
RF_feedback@w6ze.org

Submit Articles:
EDITORS@W6ZE.org

Monthly Events:

General Meeting:

Third Friday of the month
at 7:00 PM
American Red Cross
600 Parkcenter Drive
(Near Tustin Ave. & 4th St.)
Santa Ana, CA

Club Breakfast:

Second Saturday of every
month at 8:00 AM
Jagerhaus Restaurant
2525 E. Ball Road
(Ball exit off 57-Freeway)
Anaheim, CA

Club Nets (Listen for W6ZE):

28.375 ± MHz SSB
Wed- 7:30 PM - 8:30 PM
Bob AF6C, Net Control

146.55 MHz Simplex FM
Wed- 8:30 PM - 9:30 PM
Bob, WB6IXN, Net Control

7.086 ± MHz CW **OCCWN**
Sun- 9:00 AM – 10 AM
John WA6RND, Net Control

VISIT OUR WEB SITE

<http://www.w6ze.org>

for up-to-the-minute club
information, the latest
membership rosters, special
activities, back issues of RF,
links to ham-related sites,
vendors and manufacturers,
pictures of club events and much
much more.

Club Dues:

Regular Members	...\$20
Family Members*	...\$10
Teenage Members	..\$10
Club Badge**	\$3

Dues run from Jan thru Dec and are
prorated for new members.

*Additional members in the family of
a regular member pay the family rate
up to \$30 per family.

**There is a \$1.50 charge if you'd
like to have your badge mailed to
you.

OCARC Holiday Party!!!!

Friday, December 12

Come and celebrate the Holiday season with OCARC on Friday, December 12th 2015.

The dinner tickets are priced at \$29 per person and it includes the following meal choice:

- Country-Fried Steak, or
- Freshly Roasted Turkey, or
- Braised and Slow-Roasted Pot Roast,

Caesar salad, cornbread and a fountain drink, iced tea or coffee.

Slice of Pie – either Apple, Chocolate Cream or Lemon Meringue.

If you prefer **vegetarian options** they offer Pasta, Tacos or a Soup.

Meal choices must be made 5 days in advance or let us know at the time you purchase your ticket.

Check out the club Website for upcoming info www.w6ze.org .

We will be having a door prize drawing. There are over \$1000 in radio prizes – including a \$500 gift certificate. Also, all women attending will receive flower and chocolate appreciate gift.

See the club treasurer Ken-W6HHC at an OCARC general meeting, or e-mail him at w6hhc@w6ze.org to arrange purchasing your holiday party dinner tickets! Remember to bring your spouse and friends too!

We need a commitment or money from you by Dec 7!!

Mark the date on your calendar!

Friday night, December 12th at 6:00pm.

Location:

Marie Callender's Restaurant

5711 E. La Palma Ave., Anaheim, CA 92807

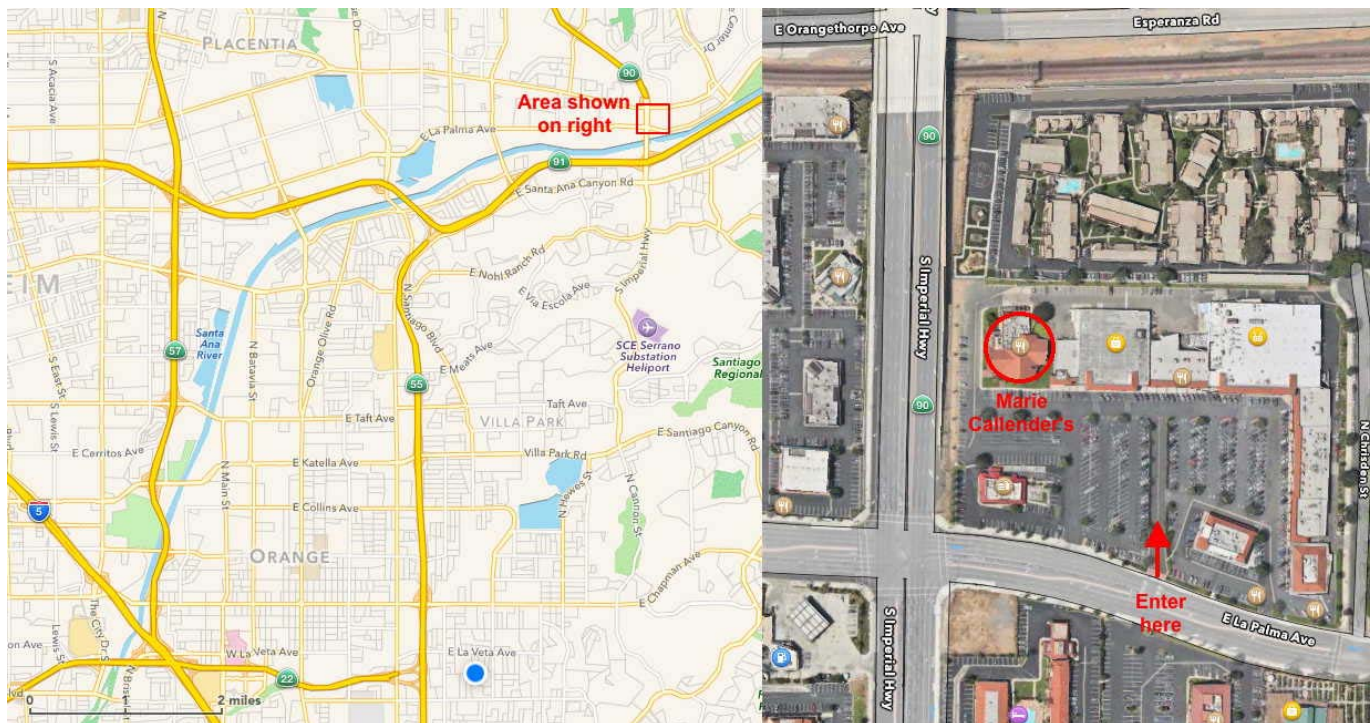
Located North of the 91 Freeway off at the Imperial Highway exit.

Restaurant is behind Carl's Jr. Recommend using u-turn signal at N. Chrisden St. and La Palma to enter the shopping center. This is just East of Imperial and La Palma.

<https://www.google.com/maps/place/5711+E+La+Palma+Ave,+Anaheim,+CA+92807/@33.8608339,-117.789654,17z/data=!3m1!4b1!4m2!3m1!1s0x80dcd1060f5d70c9:0x11a68fbc49c9b5f9>

SEE Y'ALL THERE!

Marie Callender's Restaurant - 5711 E. La Palma Ave., Anaheim, CA 92807



It is a tricky shopping center to enter. There is no entrance off Imperial and if you are going north and don't turn east on La Palma you have to travel a long way to turn around! (Up to Kellogg Road.)

2014 Field Day Results

W6ZE came in sixth overall with a score of 17,970. Congratulations to all who helped OCARC during 2014 Field Day!

1. W1AW/3 (W3AO) 36,730

2. W6YX 21,840

3. K6EI 20,125

4. K4LRG 19,028

5. W4IY 18,224

6. W6ZE 17,970

2014 Field Day

The ARRL has released the Field Day results for 2014; they are published in the December issue of **QST**. The Orange County ARC finished **sixth overall** out of 2,686 stations that submitted logs. We also placed **first in the ARRL Southwestern Division** out of 193 entries as well as **first in the Orange Section** out of 48 entries. We also finished first in the 7A class edging out K4FC by 1,036 points. We finished third overall in California.

As Chip - K7JA pointed out in an email, the two California stations the had higher overall scores were not in the 'A' category. W6YX (Stanford ARC - 2nd overall) operated 10F from an EOC allowing the use of permanent antennas, and K6EI operated 6AB battery powered with the advantage of a 5X multiplier. Still both of the stations deserve the positions they earned.

The attached graphic shows how we fared in the past thirteen years. (Years prior to 2002 are not in the ARRL data base.) If you'd like to look at our results for years prior to 2002 our scores and results are available on our website:

http://www.w6ze.org/Field_Day/FD_Scores_QST.html/

This record goes back to 1959 and was obtained from back issues of QST.

A look at this year's performance for our club can be seen at:

http://www.w6ze.org/Field_Day/FieldDay2014.html

Orange County (California) ARC FD Results - 2002 - 2014												
YEAR	SCORE	# QSOs	CLASS	FINISH: OVERALL			FINISH: SOUTHWEST DIV.			FINISH ORANGE SECTION		
				POS.	OUT OF	%	POS.	OUT OF	%	POS.	OUT OF	%
2014	17,970	5,429	7A	6	2,686	0.2%	1	193	1st	1	48	1st
2013	21,258	6,859	12A	2	2,548	0.1%	1	170	1st	1	47	1st
2012	7,684	2,264	5A	118	2,617	4.5%	7	176	4.0%	1	50	1st
2011	6,504	2,110	6A	159	2,632	6.0%	9	179	5.0%	5	49	10.2%
2010	5,936	1,878	4A	175	2,617	6.7%	14	182	7.7%	4	50	8.0%
2009	19,304	5,925	9A	3	2,603	0.1%	1	175	1st	1	45	1st
2008	11,316	3,265	9A	28	2,409	1.2%	1	161	1st	1	44	1st
2007	20,246	6,217	9A	2	2,331	0.1%	1	157	1st	1	42	1st
2006	6,278	1,836	4A	161	2,169	7.4%	7	153	4.6%	2	43	4.7%
2005	6,742	1,938	3A	128	2,199	5.8%	11	172	6.4%	2	32	6.3%
2004	5,666	1,792	4A	207	2,242	9.2%	16	152	10.5%	4	41	9.8%
2003	3,350	946	4A	426	2,079	20.5%	29	150	19.3%	6	32	18.8%
2002	4,928	1,517	4A	303	2,099	14.4%	20	139	14.4%	4	42	9.5%
de AF6C												

2014 OCARC Auction Report

– Great Fun and Great SUCCESS

This year, our auctioneer Chip K7JA did another terrific job of auctioning off 64 items. It was a lot of fun.... and the OCARC is thankful for the large crowd of “buyers” and the large number of items brought to the auction. Club Treasurer, Ken W6HHC, reported that the club auction sales totaled \$1,796 (income). The net profit for the club this year was around \$684. “El Presidente” Nicholas AF6CF explained that the large profits were due to the many generous people that had donated equipment for the Auction. (photos are thanks to Bob AF6C)



Figure 1 –Part of Auction Crowd



Figure 2 –View of part of the Auction Equipment



Figure 3 – Chip K7JA was the OCARC Auctioneer

2014 JOTA Special Event

Bob AA6PW and Arnie N6HC went to the 2014 BSA JOTA special event on October 18, 2014 at the Firestone Scout Reservation in Brea, California (Tonner Canyon) to assist the scouts in contacting other JOTA stations. The station, antennas and tower were provided by Dino KX6D. Everyone had a great time.

Arnie N6HC



LIST OF THOSE NOMINATED FOR THE OCARC 2015 BOARD OF DIRECTORS

Others can be nominated at the November General Meeting.

1. PRESIDENT — Tim Millard N6TNT
2. VICE PRESIDENT — Tom Cowart W6ETC
3. TREASURER — Greg Bohning W6ATB
4. SECRETARY — Ken Konechy W6HHC
5. ACTIVITIES — **OPEN**
6. MEMBERSHIP — **OPEN**
7. PUBLICITY — Robbie Robinson KB6CJZ
8. TECHNICAL — **OPEN**
9. DIRECTOR AT LARGE — Nicholas AF6CF
10. DIRECTOR AT LARGE — **OPEN**

More than one person can run for any position on the Board.

This list of nominated names is not final or “all inclusive” and it is subject to change at or before the November 21 Elections. As stated earlier, members can be nominated from the floor during the election...plus, members may also nominate themselves.

If you want to run for a position on the OCARC Board of Directors, please contact the Nomination Committee Chair Greg W6ATB (W6ATB@W6ZE.org) or President Nicholas AF6CF (AF6CF@W6ZE.org).

TechTalk116

DigitalATV – Using ODROID with DATV-Express board

by Ken W6HHC

In TechTalk109, I discussed how to use the DATV-Express exciter board with an Intel based Linux PC.

In this follow-up article, I will discuss the next stage of the project, which is replacing the PC with a small, more portable, low powered ARM-based board. In particular, I will concentrate on the ODROID model U3 platform."



Figure 1 – Production DATV-Express hardware board for Digital-ATV

After the main Linux DATV-Express software was released earlier this year, the project team looked at the possibility using the following "micro-PC's" to drive the DATV-Express hardware board:

- Raspberry Pi (single-core-ARM based)
- RikoMagic MK802iv (quad-core-ARM based)
- HardKernel ODROID U3 (quad-core-ARM)

ODROID Model U3

The Raspberry Pi and the MK802iv units that were tested with the DATV-Express hardware board and software...each had problems when with our project. The single-core-ARM Raspberry Pi, running at 700 MHz, was underpowered for our particular use. The MK802iv had issues with the completeness of its software repositories...that prevented easily recompiling the linux kernel software. The small ODROID U3 (see **Fig03**), quad-core-ARM CPU running at 1.7 GHz, was tested and proven to be suitable for meeting our DVB-S goals.



Figure 3 - Size of quadcore-ARM ODROID-U3 board is about the same size as Raspberry Pi

Fig02, below, illustrates a typical transmitter set-up for using the ODROID U3 to drive the DATV-Express board in a typical DVB-S operation. This approach uses a USB2-based Hauppauge model HVR-1900 (PAL) or the HVR-1950 (NTSC) to perform video capture

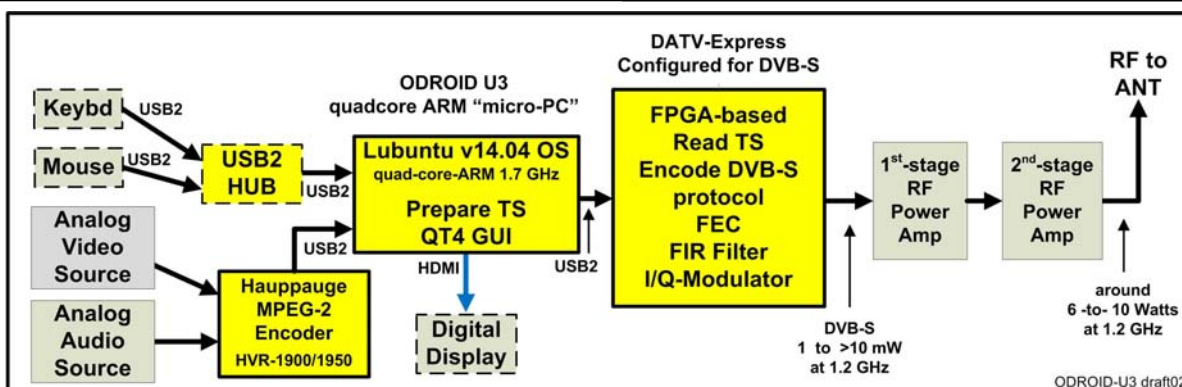


Figure 2 – Typical Block Diagram of ODROID DVB-S transmitter using DATV-Express

and MPEG-2 encoding. The MPEG-2 video and audio elementary streams are sent by a USB2 interface to the ODROID for processing into a Transport Stream (TS).

The first step that project-member Charles G4GUO took to get ready for allowing the software program to work with the “micro-PC” ARM computers was to move the DVB-S protocol processing into the FPGA coding, in order to off-load the processing on the ODROID. The quad-core-ARM is not as powerful as an equivalent Intel quad-core i5 or i7 CPU.

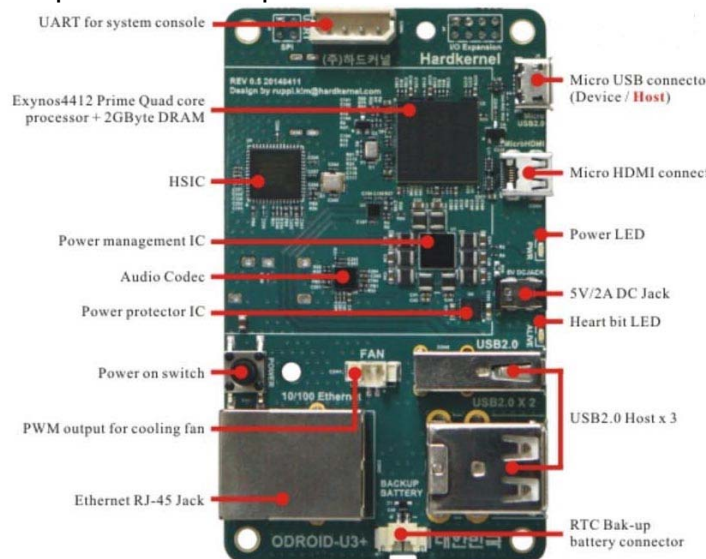


Figure 4 – The top side of the ODROID U3 board. The Heatsink on top of the Exynos Quad-Core CPU is not shown. Three USB2 connectors shown on right side, near bottom.

The ODROID U3 runs with a light-weight version of Ubuntu 14.04 LTS operating system that is called Lubuntu 14.04 LTS. Lubuntu uses a small desk-top-environment called LXDE. It is recommended that the image of the Lubuntu 14.04 LTS OS be placed on a micro-SD memory chip, not the available eMMC memory module. You either need to: (a) purchase a micro-SD from HardKernel with the OS installed ...or... (b) just purchase a “class 10 speed” 8 GB (or larger) micro-SD chip from your local computer store, download the OS image from HardKernel (no cost) and burn the OS image onto the micro-SD chip. Plug the micro-SD memory chip into the slot shown in **Fig05**.

Running ODROID with DATV-Express

The first steps to operate the ODROID are to attach the WiFi or Ethernet connection for the ODROID, leave off the hardware board & Hauppauge cables,

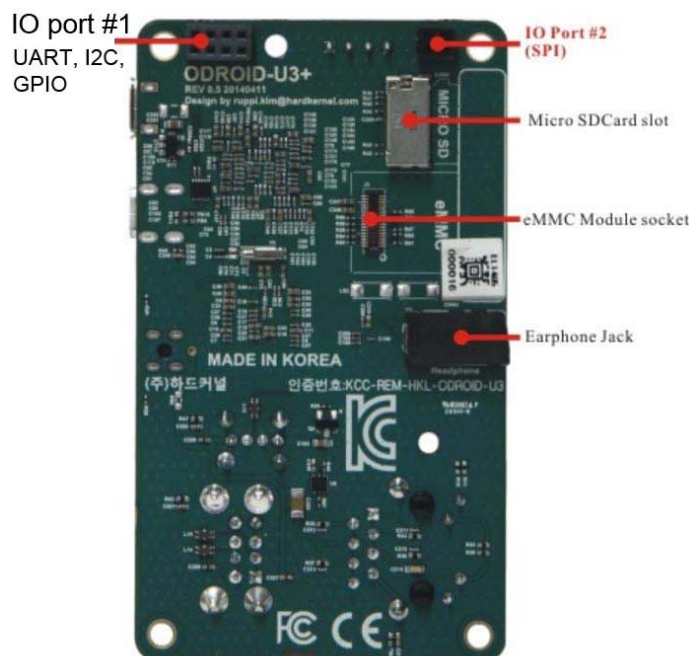


Figure 5 – The bottom side of ODROID U3. The micro-SD memory slot is shown on right side near the top

connect the micro-HDMI-adapter-cable to a display, and connect the power-adapter (wall-wart) to the ODROID to power-up. You should see the ODROID boot-up on the display (with a blinking blue-LED on the ODROID board). At this point it is necessary to enable the WiFi or Ethernet connection to internet. More detailed instructions will be available in the DATV-Express User Guide for ODROID (coming soon to the www.DATV-Express web site).

Place the correct DATV-Express .deb file (for ARMhf) on the ODROID desktop...and double-click the file to install the DATV-Express software. You will need to modify one system file for access rights for USB (same as PC versions) and then you can remove the internet connection and attach the hardware board and Hauppauge video-capture unit.

Testing DATV-Express with ODROID

The DATV-Express software binary can be launched from the System Menu in the lower left-hand corner of the Lubuntu desktop. As shown in **Fig06**, the DATV-Express application is listed in the SOUND & VIDEO area in the system menu. Just click on it and it launches the app. The DATV-Express graphic user



Figure 6 – The DATV-Express application can be launched from the System Menu of the Ubuntu Desktop

interface (GUI) looks essentially the same (see **Fig07**) as the GUI that displays on the Ubuntu PC installations. The set-up and configuration is also essentially the same....except most operating will use EXPRESS-AUTO mode (in HW Tab) to offload processing from the ODROID for DVB-S operations.

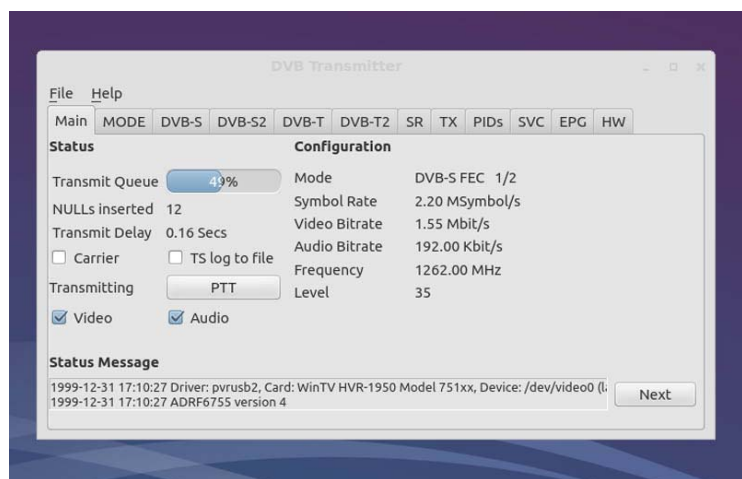


Figure 7 – The DATV-Express GUI for ODROID looks essentially the same as when installed on Ubuntu on a PC

Fig08 shows the ODROID set-up to operate and drive the DATV-Express board (not shown - off to the right). A non-powered USB-hub can be seen to the right of ODROID for connecting a mouse and keyboard. The Cisco USB WiFi unit, purchased from HardKernel, can be seen lying unconnected on the desk to the left of ODROID.

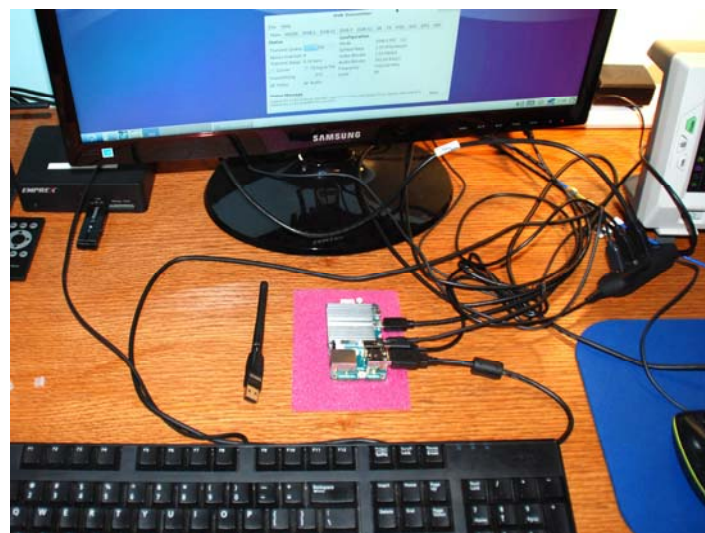


Figure 8 – Set-up to use ODROID U3 to test with DATV-Express board at QTH of W6HHC

Fig09 shows the normal DVB-S “haystack” during “barefoot” testing as displayed on a Spectrum Analyzer. This test was operated on 1262 MHz with a 3 MHz bandwidth ($BW_{\text{allocation}}$) using 2.2 MSymb/sec Symbol Rate (SR).

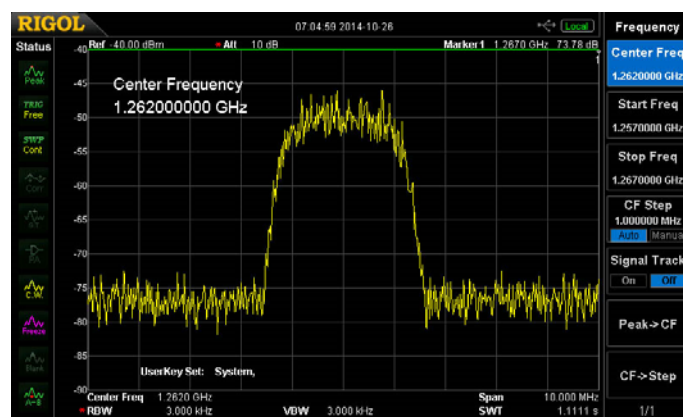


Figure 9 – Spectrum Analyzer display of “Barefoot” testing of DATV-Express exciter board using DVB-S on 1.2 GHz band.

The RF coming from the DATV-Express hardware board driven by the ODROID should not be any different than when the board is being operated with a full-size PC. To confirm this, I hooked up a model MKU-P1301A first-stage RF Power Amp made by Kuhne (in Germany). This RF amp is rated at 1 W (FM) and is the same amplifier that I used to bench test the DATV-Express board driven by a PC. As expected, **Fig10** shows that same reasonably shaped DVB-S “haystack” that was also produced when testing with Ubuntu on a PC.

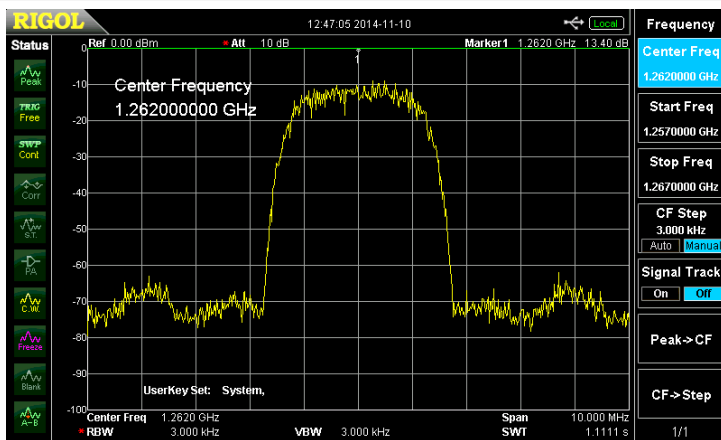


Figure 10 – Spectrum Analyzer display of DATV-Express driving a Kuhne 1.2 GHz RF Power Amp rated at 1W (FM)

The average output power measured in **Fig10** was about 40 mW...enough to easily drive my DownEast second-stage RF PA (30 W FM) on the 1.2 GHz to about 6-to-8 W average power out.

The DATV-Express board was originally designed to just run DVB-S protocol. But, the project team is always curious if it can also run DVB-T. One of the first tests I ran on the ODROID U3 was to try the new 1 MHz bandwidth mode for DVB-T that was added in the v2.03 release of software.

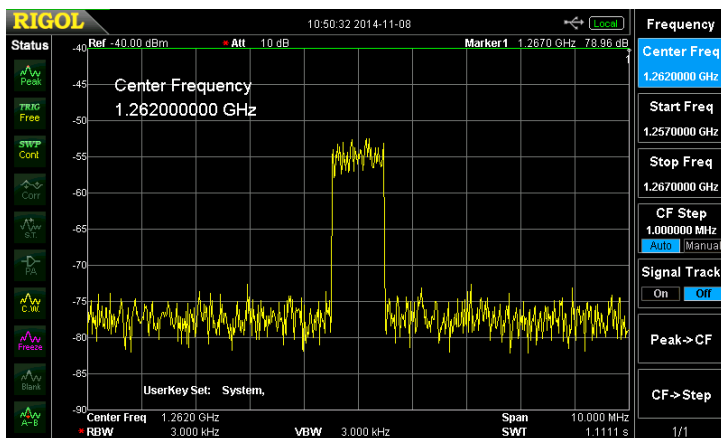


Figure 11 – Spectrum Analyzer of the ODROID driving the Hardware Board in the 1 MHz BW mode with DVB-T protocol. The SA display span is 10 MHz.

Fig11 was taken using QPSK modulation and FEC=1/2. I do NOT have a DVB-T receiver, so I can not view the video quality. With that modulation and FEC setting, the GUI reported the video data rate at about 0.3 Mbps, which would only support a slow video display frame-rate. If I change the FEC setting to 7/8, then the GUI reports the video data-bit-rate increased to about 0.7 Mbps. Of course, the modulation for the

1 MHz bandwidth mode could be changed to use QAM-16 in order to support a higher video data rate (although with some loss of signal robustness introduced by the increased-modulation-complexity). I also tested DVB-T with QPSK in the 2 MHz BW mode. Using an alpha-test build of the software, one of the four ODROID CPUs was **NOT** able to keep up with the required processing load for the 2 MHz BW testing. Charles G4GUO suspects that further DVB-T load-reduction improvements could possibly be done by rewriting parts of the software in assembly language (but, will not occur soon).

Release of ODROID SW for DATV-Express

The project team plan for ODROID release is to:

1. need to complete the test of the resulting v2.03 installation on ODROID-U3 to make sure that all features work well.
2. A stand-alone ODROID-version of the USER GUIDE needs to be prepared (many Lubuntu screens look different)

My current expectation is that these tasks will all be completed, released, and available on the DATV-Express web site by the end of November.

Possible Future Roadmap with ODROID

The DATV-Express project team recognizes that currently, the Hauppauge approach for video-capture creates two large problems for our project:

- (1) The timing on the Hauppauge PCR with a linux driver seems to be very jittery. G4GUO has retimed the PCR and re-stamped the packets, but not perfectly.
- (2) Hauppauge has come out with two new HVR models; HVR-1905 (PAL) and HVR-1955 (NTSC) but have not yet come out with the Linux drivers - - creating a DATV-Express problem for buyers of those new models.

Alex OZ9AEC has been experimenting with a Logitech web camera, that outputs the video stream with H264 (aka MPEG-4) encoding. The Logitech model C920 web camera is small and even has mounting for a tripod.

The only issue with this nice and affordable web camera is that the audio has not been encoded by MPEG-4. My personal suspicion is that Logitech may be attempting to avoid paying a license fee for AC3 (a licensed CODEC by Dolby), the normal audio for H.264? So one approach could be - to encode the C920 camera audio processing a CPU CODEC for MPEG-4 or MPEG-2 on the ODROID?

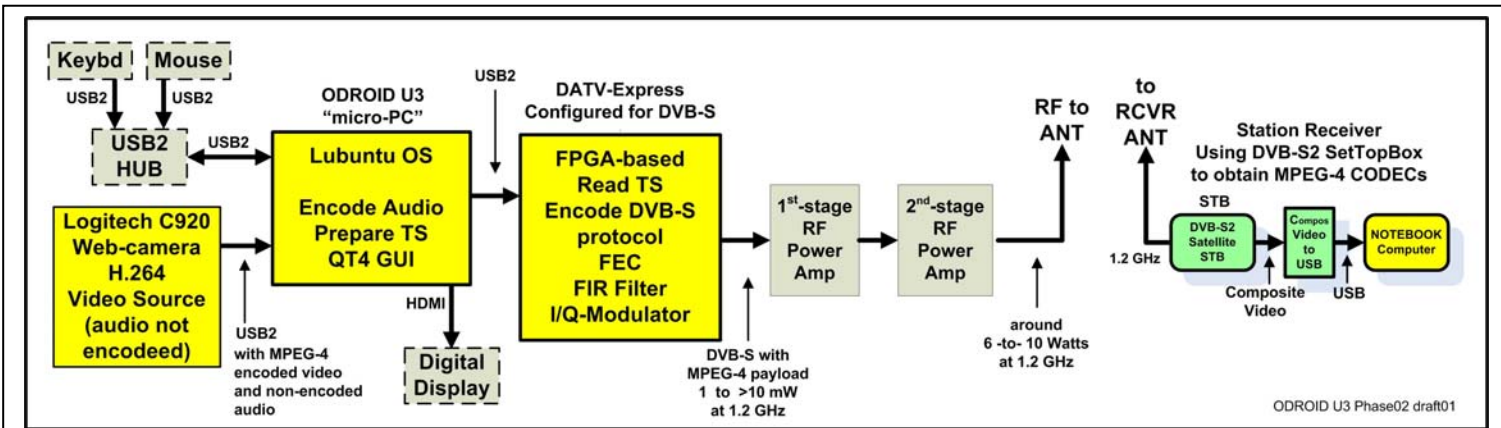


Figure 12 – Possible “concept” Block Diagram of ODROID DVB-S transmitter using C920 Web camera that outputs H.264 encoded video stream

Fig 12 is a concept block diagram of ODROID U3 using the Logitech C920 web camera to transmit H.264 video with DVB-S DATV protocol. The receiver is required to be a DVB-S2 STB receiver or DVB-S2 USB-dongle-receiver that is also capable of receiving legacy DVB-S protocols. Note that this is not a normal commercial protocol. Also note that Logitech does not supply linux drivers ...but do support the UVC standards supporting cameras in linux distributions. So there may be an issue with the Lubuntu distribution? But, the project team thinks this might work for DATV??

The team plans to take some time to investigate and sort out these potential C920 issues.

Conclusion

The ODROID U3 “micro-PC” works very well with the DATV-Express DATV exciter board, especially for the DVB-S protocol. It makes the use of a DATV-Express transmitting station more portable by eliminating a large PC or a bulky notebook computer. The ODROID U3 is fairly affordably priced at US\$65 (70 Euro) plus plastic-case, 5V/2A power adapter (wall-wart) and shipping.

Useful URLs

- ATCO - Amateur Television of Central Ohio – see www.ATCO.tv
- British ATV Club - Digital Forum – see www.BATC.org.UK/forum/
- CQ-DATV online (free monthly) e-magazine – see www.CQ-DATV.mobi
- DATV-Express Project for Digital-ATV (User Guide and downloads) – see www.DATV-Express.com
- HardKernel web site for ODROID U3 – see www.hardkernel.com/
- HardKernel USA Sales for faster shipping – see www.ameridroid.com
- HardKernel web site for free ODROID Magazine – see <http://Magazine.Odroid.com>
- OZ9AEC discussions on using Logitech model C920 web camera – see www.OZ9AEC.net/index.php/gstreamer/473-using-the-logitech-c920-webcam-with-gstreamer
- Orange County ARC entire series of newsletter DATV articles and DATV presentations – see www.W6ZE.org/DATV/
- Yahoo Group for Digital ATV - see groups.yahoo.com/group/DigitalATV/

Heathkit® of the Month #61:
by Bob Eckweiler, AF6C



Heathkit® SG-8
Low-Cost RF Signal Generator.
TEST EQUIPMENT

Update to HOM #32:

Back in August of 2011 I covered the Heathkit® LG-1 Laboratory RF Signal Generator and one of its successors, the IG-42. I failed to mention an even later laboratory generator, the IG-5242 which is electrically identical to the IG-42 and LG-1 except in the primary AC wiring circuitry. The LG-1 can be wired only for 120V operation. The IG-42 began as just a styling change to the LG-1; (though an export model was available for 240V 50 Hz). Sometime between May of 1969 and 1972 the export model was dropped and 120/240 volt 50/60 Hz operation became standard; this was done without a change in the model number. The later IG-5242 was another styling change and again the primary wiring was changed, adding a three-wire grounded plug and a fuse. I could not find a manual, a schematic, nor even a catalog listing that includes the IG-5242. It was not yet introduced in my Spring 1977 catalog and no longer listed in my Fall 1980 catalog, yet it existed between those dates.

In HOM #32 I also briefly mentioned the G-4 HF AM Signal Generator that seemed to be a mystery. According to Chuck Penson's *Heathkit Test Equipment Products* book* the G-4 was short lived and advertised only in one 1949 Heathkit flyer. It covers 32 to 110 Mc and includes a calibrated 64 to 220 Mc harmonic scale. It was designed to continue upward in frequency coverage from where the G-1 stops.



Figure 1: Heathkit® SG-8 RF Signal Generator

Table I shows the complete Heathkit RF signal generator line. Dates and prices are as best I could determine reviewing my catalogs and on-line catalogs I have found.

Introduction:

An RF signal generator is a must for anyone doing repair or alignment of old of receivers or even just tinkering around with amateur radio. Heathkit recognized this, and produced over the years a series of RF signal generators in four distinct categories (shown in Table I), as well as numerous other RF sweep oscillators for general and specific purposes.

The Laboratory RF generators were covered in the earlier HOM article, and the IG-5280 is part of the 5280 "Starter Test Bench" series and will be discussed if and when the series is covered. We'll briefly touch on the "2% accurate" RF general purpose generator group later. The focus of HOM #61 will be on the low-cost general purpose SG-8, the last of the low-cost general purpose line. The members of this family were briefly discussed in the earlier article, but since so many SG-8s are still in use and easily available it should be covered in a bit more detail.

Heathkit General Purpose RF Signal Generators:

All the low-cost general purpose series RF signal generators use two tubes. In the early G1 and G5 one of those tubes is a 6X5 rectifier tube; the

other is a 6SN7 dual triode. In the later SG-6, SG-7 and SG-8 a selenium rectifier replaces the rectifier tube. The SG-6 and SG-7 use two separate 6C4 triodes instead of the 6SN7 dual triode. The SG-8 (Figure 1) uses one 6C4 and one 12AU7 dual triode, thus adding a third triode section. The tube lineups are listed in Table II. The smaller 6C4 and 12AU7 tubes allow the later generators to operate up over 100 mc instead of below 50 mc. All these generators have built-in modulation. The G1 and G5 use a neon bulb relaxation oscillator driving one of the triodes and modulating the second RF oscillator triode. The SG-6 through 8 use a 6C4 as a audio Colpitts oscillator for the modulator; this produces a more sinusoidal tone than the high harmonic audio tone of the relaxation oscillator. The SG-6 through SG-8 use the same circuit for the audio section, with the exception of the input and output connectors, which were changed from 1/4" phone jacks to the, now hard to find, Amphenol 75 series connectors.

The SG-8 RF Signal Generator:

The SG-8 was sold between the Fall of 1953 and early 1961. In the May 1961 catalog the only RF generator shown was the later RF-1. It overlapped the SG-8 for a period of time.

The SG-8 is a simple RF signal generator. For its low cost I was surprised at how accurately and stably it performs. This signal generator covers 160 kc to 110 mc in five bands. A sixth scale covers 110 to 220 mc on the harmonic of the fifth band. The band coverage is given in table III.

Heathkit® RF SIGNAL GENERATORS

General Purpose - Tube

Model	Range Mc	Intro.	Price	Last	Price
G-1	0.15 - 32 ⁵	Jan. 48	\$19.50	Aug. 49	\$19.50
G-4	32 - 110 ^{1,4}	Apr. 49	\$19.50	< Jun. 49	\$19.50
G-5	0.15 - 34 ^{2,5}	Sep. 49	\$19.50	Aug. 50	\$19.50
SG-6	0.16 - 50 ^{3,5}	Sep. 50	\$19.50	Aug. 52	\$19.50
SG-7	0.16 - 50 ^{3,5}	Sep. 52	\$19.50	Aug. 53	\$19.50
SG-8	0.16 - 110 ^{1,5}	Sep. 53	\$19.50	< May 61	\$19.50?

"2% Accurate" General Purpose - Tube

Model	Range MHz	Intro.	Price	Last	Price
RF-1	0.10 - 110 ^{1,6}	59	\$27.95	63	\$27.95?
IG-102	0.10 - 110 ^{1,6}	62	\$29.95	77	\$56.95

Starter Test Bench - Solid-State

IG-5280	0.31 - 110 ^{1,5}	77	\$37.95	Sep. 90	\$119.95
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Laboratory Grade - Tube

LG-1	0.10 - 30 ⁵	Sep. 53	\$39.50	62	??
IG-42	0.10 - 30 ⁵	63	\$59.00	78	\$109.95
IG-5242	0.10 - 30 ⁵	78	\$119.95	80	\$119.95

Notes:

- ¹ Calibrated harmonics to 220 Mc.
- ² Calibrated harmonics to 102 Mc.
- ³ Calibrated harmonics to 150 Mc.
- ⁴ A single fundamental band.
- ⁵ Five fundamental bands.
- ⁶ Six fundamental bands.

Table I

The front panel includes five controls plus the main tuning knob, which is a 6:1 vernier drive; also on the front panel are three Amphenol receptacles and a big green pilot lamp. The front panel controls are listed in table IV. The rear of the SG-8 contains only a grommet for the exiting AC power cable.

Operation amounts to letting the signal generator warm up for a reasonable period. The RF tuning is then set to the desired frequency. Use of an external calibrated receiver or frequency

Heathkit® Low Cost General Purpose Signal Generator Tube Lineup

#*	Type	Function
G-1 and G-5		
V1	6X5	Rectifier
V2a	1/2-6SN7	Amp/Modulator
V2b	1/2-6SN7	RF Oscillator
SG-6** and SG-7**		
V1	6C4	AF Osc/Amp
V2	6C4	RF Oscillator
SG-8**		
V1	6C4	AF Oscillator
V2a	1/2-12AU7	RF Oscillator
V2b	1/2-12AU7	Buffer Follower

Notes:

* No 'V' designations given in manual on these models.

** Selenium rectifier used in place of a vacuum tube rectifier.

Table II

counter can enhance accuracy. If you want the RF carrier modulated, place the **MODULATION** switch to **INT**ernal and adjust the **AF IN-OUT** control for the desired level of modulation. You may instead apply an external audio signal to the **AF IN** receptacle with the MODULATION switch in the **EXT**ernal position. The RF level output is coarsely adjusted by the **RF STEPS** switch and finely adjusted with the **RF OUTPUT** potentiometer. Maximum RF output is specified as more than 100,000 μ V.

The internal modulator audio (approximately 400 Hz) is available at the **AF OUT** receptacle with the MODULATION switch set to **INT**ernal. The audio output level is specified at 2 to 3 volts

Heathkit® SG-8 Frequency Range

Band A	160 kc	500 kc
Band B	500 kc	1650 kc
Band C	1.65 mc	6.5 mc
Band D	6.5 mc	25 mc
Band E	25 mc	110 mc
Band E (Harm.)	110 mc	220 mc

Table III

Heathkit® SG-8 Front Panel Controls

Top Row - (Left to Right)

(AF) OUT Microphone type receptacle (M)
Amphenol 75-PC1M*

Pilot Light Green with #47 bulb

Middle Row (Left to Right)

(AF) IN Microphone type receptacle (M)
Amphenol 75-PC1M*

(Tuning) Dual split variable capacitor
(6:1 vernier drive)

Large six-scale frequency dial

RF OUT Microphone type receptacle (M)
Amphenol 75-PC1M*

Bottom Row (Left to Right)

MODULATION Rotary Switch (2-position)
EXT. – INT.

AF IN-OUT Potentiometer
Arc line with arrows at ends

(Band) Rotary Switch (5-position)
A, B, C, D, E

RF OUTPUT Potentiometer with CCW AC switch
(w/ AC Power) **AC OFF**, Arc line with arrows at ends

RF STEPS Rotary switch (3-position 60°)
Just a line for pos. 1 & 2; **HI** for pos. 3

Table IV

maximum and is adjustable downward by the AF IN-OUT control.

Heathkit® SG-8 Circuit Description

The circuit of the SG-8 is quite straight forward and may be separated into four sections: the power supply, the audio oscillator, the RF oscillator and the cathode-follower and attenuator circuits. The schematic is shown in Figure 5.

The Power Supply:

There is not much to say here. B+ is obtained from a transformer fed half-wave power supply that utilizes a selenium rectifier and an RC filter composed of two 20 μ F electrolytic capacitors separated by a 3.3K Ω resistance. The transformer also has a second winding that supplies filament current to the two tubes and the pilot lamp. Both sides of the AC line are bypassed with 0.01 μ F capacitors to help decou-

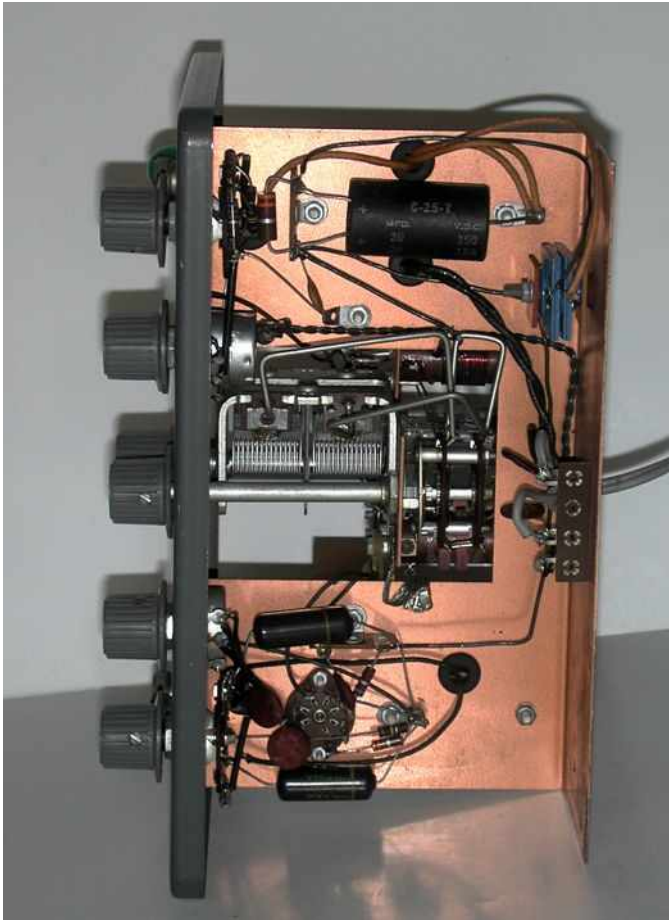


Figure 2: SG-8 RF Generator Bottom View.
The dual tubular electrolytic capacitor is the large black cylinder near at the top, with the blue selenium rectifier to its lower right. The dual tuning capacitor is in the center, and near the bottom is the socket for the 6C4 tube. The two black cylinders above and below the tube socket are the two molded paper capacitors.

ple the power cord and prevent it from leaking RF energy. The higher cost Heathkit© signal generators use pi-filters for the same purpose.

The Audio Oscillator:

The 400 cycle per second (nominal) oscillator is a simple audio Colpitts oscillator that uses a transformer style 1 Henry AF choke shunted by two series capacitors. The connection between the two capacitors is grounded. Feedback to sustain oscillation is developed across one of the capacitors while the other provides energy from the plate circuit of the 6C4 triode. The transformer and capacitors are only switched

in when INTERNAL MODULATION is selected. In this position the 400 cps is also available at the AF OUTPUT receptacle. The level is controlled by the AF IN-OUT control and can provide a high impedance sine wave up to 2 to 3 volts.

In the EXTERNAL position the 6C4 acts as an audio amplifier connected to the AF INPUT connector, again through the same AF IN-OUT control. About 5 volts of audio across the 1 MΩ external input will give about the same level of modulation as when using the internal 400 cps oscillator. The maximum modulation level is not mentioned in the manual. Figure 2 shows the under-chassis with the 6C4 at the bottom.

The RF Oscillator:

The RF oscillator is also a Colpitts oscillator using one-half of a 12AU7 triode; 450 pF/450 pF dual variable capacitors in series with their common lead grounded and a switched inductor make up the tuned circuit. The inductors on the lower four bands (A through D) are factory calibrated coils that are switched in by the band switch. The dual variable capacitor, the RF coils, the band switch and the 12AU7 RF oscillator tube all mount on a vertical sub-chassis which greatly reduces lead length (Fig. 3).

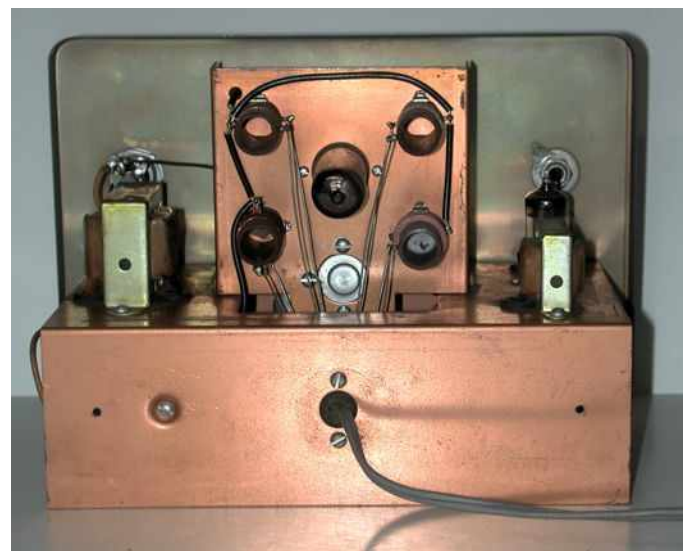


Figure 3: SG-8 RF Vertical Sub-chassis
showing the 12AU7 tube surrounded by the band A through D coils. On the left is the power transformer and on the right is the audio choke.

A very clever part of the SG-8 is the way Band E is implemented. Whoever thought this idea up hopefully got a big raise! The four lower-band coils are all wired normally to the band switch as are the coil center-taps where the RF oscillator voltage is applied. However the wiring from the switch to the dual variable capacitor consists of three heavy-gauge uninsulated, plated and formed wires. These heavy wires connect the band switch to the variable capacitors and the center-tap connections on the band switch together. When using the bands A through D these wires are just conductors, but on band E these heavy wires actually make up the band-E coil (Not to be confused with E Coli or Ebola!) Figure 4 shows the band-E coil wires.



Figure 4: Close-up bottom view showing the three (gray) heavy formed wires that make up the band-E coil.

There are no tuning slugs in the band coils nor are there any trimmer capacitors. The accuracy relies on the factory wound coils and the kit-builder's prowess.

The Follower and Attenuator Circuit:

The second triode section of the 12AU7 tube mounted horizontally on the sub-chassis is wired as a cathode follower. This provides high impedance to the oscillator so that changing loads will have little effect on the oscillator frequency, and low output impedance so that 50 Ω cable can be driven without a lot of loss.

The follower triode is capacitively coupled to the output of the RF oscillator. It is also capaci-

tively coupled to the output of the 6C4 audio oscillator/modulator. If audio is present the result is audio modulated RF at a low impedance at the cathode of the follower triode. This RF is developed across a 1K Ω resistor in series with the 1K Ω **RF OUTPUT** potentiometer. Output from the potentiometer goes to the three position **RF STEPS** switch which has two 24 dB attenuators that are switched out as the switch is rotated from left to right. At the full right position no additional attenuation, other than the RF OUTPUT potentiometer is in the circuit.

The "2% Accurate" General Purpose Series:

In late 1959, while the SG-8 was still in production, Heathkit© introduced the RF-1. Up to that time none of the signal generators advertised a specified accuracy, not even the laboratory generators. The frequency accuracy of the SG-8 was never specified in any ads that I could find, but is mentioned on page 15 of the SG-8 manual: *"The [SG-8] may be expected to fall within 2 to 3% of the frequency calibration..."*. The RF-1 accuracy was advertised as 2%. It features six overlapping bands in a "1 - 3.2, 3.1 - 11" sequence. It also includes a 100 - 220 mc harmonic scale. In 1961 the SG-8 was dropped, leaving the RF-1 as the "low-cost" RF signal generator product.

Both the RF-1 and the later IG-102 came with a factory wired and adjusted coil-band-switch assembly. The manual gives instructions for basic alignment using a simple AM/FM broadcast radio.

The RF-1 underwent a styling change in 1962 and became the IG-102 which remained in production into 1977. By that time it had more than doubled in price over the original cost of the RF-1. There were no changes I could detect in the circuits of these two units. The IG-102 did receive an updated transformer to allow 120/240 volt operation around the time the IG-42 received the same update. In Chuck Penson's book, he shows a photo of an IG-102 updated in style to the cream color scheme.

Conclusion:

The SG-8 used in this article came into my collection fairly recently. My main RF signal generator for many years was a PACO S-50 signal generator that was similar to the SG-8 but had a much more precision tuning dial. During college I used the SG-8 in some lab classes. Some years back I picked up an old Heathkit® LG-1 lab generator that was restored to working condition and used in place of the S-50.

The fact that the SG-8 has no calibration adjustments, other than aligning the vernier pointer on the scale, worried me at first. But I soon found that even after 52 or more years the calibration was still within the 2 to 3% frequency specification of a new kit. Of course, today that is a large error, up to 0.9 mc at 30 mc. This problem is easily overcome by using the generator at a higher level output that can drive a frequency counter and then also using an external attenuator to reduce the signal to the device under test. I also happily found that, once the generator is warmed up, the frequency drift is small and easily manageable, a lot better than my PACO S-50 signal generator of the same era.

My current SG-8 appears well built and is in good condition. The kit appears original with no modifications, nor component replacements. The only non-disc or mica capacitors in the SG-8 are the two-section axial electrolytic power supply capacitor that mounts under the chassis (2 x 20 µF at 150V) and the two molded paper capacitors (0.1 and 0.02 µF) that are part of the audio oscillator. After bringing up the voltage slowly on a variable transformer, a quick check of the AC ripple on the B+ showed the 50+ year old electrolytic capacitors are still performing. The two molded paper capacitors were not even checked as their weakness would result in no audio oscillation or one way off the 400 cps specification. I may replace these capacitors in the future. The two capacitors I am replacing are the 0.01 µF line filter capacitors that go between the AC power and ground. These will be replaced with modern capacitors designed just for this purpose. Perhaps a three-

wire AC cord with a ground and the installation of an internal fuse in the hot lead are also reasonable future modifications?

None of the non-laboratory Heathkit signal generators tell you the RF voltage. The Lab generators have a voltmeter before the attenuator so you can get an accurate idea of the signal being applied to the device under test. However, that accuracy depends on proper termination.

Final Comments:

I'd like to thank two hams who have added to my catalog files to help me look up prices and dates of Heathkit products. Club president Nicholas - AF6CF passed along a Summer 1991 catalog that I had never even seen before and Eugene Colton - AF9O sent a spare 1969 catalog from lovely Santa Fe, NM. The 1969 catalog fills an important hole for me as it was probably from that same catalog that I ordered my SB-301/401 station shortly after starting my first job out of college. Many of my earlier Heathkit catalogs disappeared during a move at work that occurred while I was on a test across the county. Blame a pointy-haired boss!

73, from AF6C

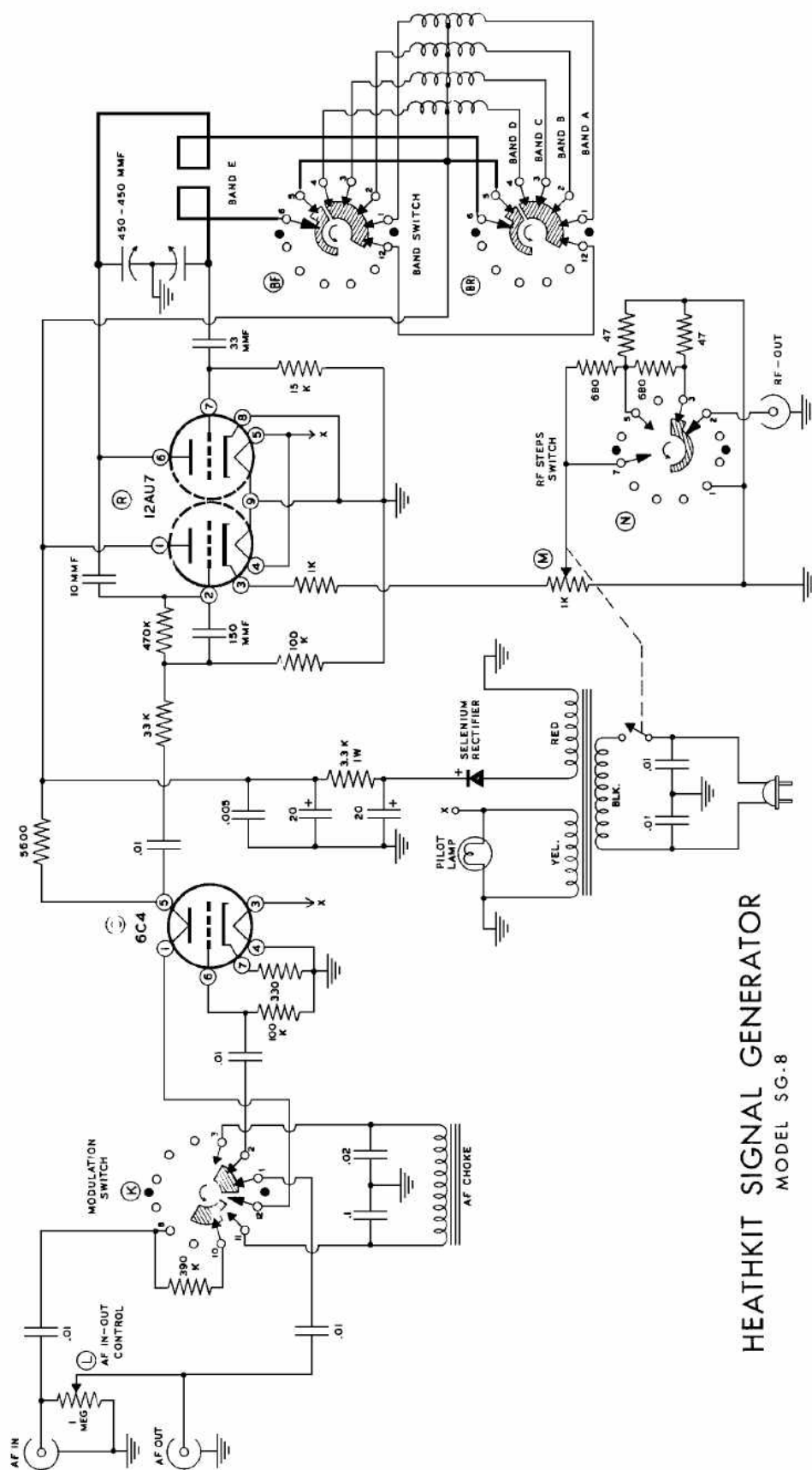


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Remember, if you are getting rid of any old Heathkit Manuals or Catalogs, please pass them along to me for my research.

Thanks - AF6C

*** Heathkit Test Equipment Products** by Chuck Penson - WA7ZZE is available through Amazon and other book sources. If you are interested in Heathkit, it is worth having in your library. I recommend it highly! See my review in the July 2014 issue of RF (page 8).



HEATHKIT SIGNAL GENERATOR
MODEL SG-8

OCARC Board Meeting Minutes for: October 11, 2014

The OCARC Board meeting was held at the JägerHaus Restaurant, 2525 East Ball Road, Anaheim, and called to order by President Nicholas AF6CF on Saturday, October 11, 2014 at 8:15 am. All directors were in attendance.

DIRECTOR REPORTS

Pres – no report

VP – picking up various donated items for the auction. Also, let us know that Greg – W6ATB called and he is delayed in arriving due to police shutdown of streets in his neighborhood. He will be with us as soon as possible.

Treas –received dues check from new member Ed Dowler.

Sec. – dues check from new member Ed Dowler received in mail. Director at Large – Tom W6ETC wondered if we send out a standard “welcome” letter to new members? Answer – we have not recently, however, Bob – AF6C will forward a sample letter, for the board members consideration of what we could be doing in this regard. Tim will not be able to attend the October Auction.

Activities – Paul – no report.

Membership – Doug report we current have 103 members, additionally there are 14 honorees on the roster. It was requested that Doug send out a copy of the latest roster to Ken. Ken can then email it out to the membership. Doug will not be able to attend either of the November meetings or the October Auction.

Tech. – Bob has temporary badges for guest and visitors that come to our General Meetings. He is also going to help an new ham setup his equipment at a home in Anaheim Hills. Bob will be bring a number of items to the club auction.

Pub. – Robbie - auction flyer's and club information sheets delivered to HRO. Nicholas delivered same to Ford Electronics.

Director at Large – Tom – W6ETC made it clear that he is available to assist with web site changes. Ken said there should be a time in the next week when they would get together for just that purpose. Tom also wonder if the board would consider moving their meeting during the next year. He is also a member of CARA and because their meetings occur every other month at the same time as our board meetings he is unable to participate in that group as he would like. Several other board members agreed that there have been times when they also would like to attend CARA meetings but are unable because of our schedule. Since there is only 1 more board meeting this year, it was agreed that the “in coming” board should take this matter under consideration.

Old Business:

- 1.) **Newsletter Editors:** Nov-W6ATB, Dec-W6HHC, Jan-N6TMT, Feb-W6FKX
- 2.) **General Meeting Entertainment,** November – Dennis Kidder – W6DQ – “History of Receivers – Part 2, December 12th Christmas Party, Tim G. is working on a speaker for January.
- 3.) **FD 2014: Chairpersons and Doc status report.** –Chairpersons stated that we should know the formal standing when ARRL releases results in early November, no “whisper numbers” have been revealed. The FD planning document is moving along. Need input from the various Captains to improve the details on their duties.
- 4.) **2015 Field Day Site Selection** – FD 2015 is June 27th and 28th. Tim G. will be reaching out to Carla at School District office in the next week to see if we can get on the schedule.
- 5.) **Board Monthly Planner Document** –Bob will email out a copy of the document today.

- 6.) October Auction Prep.** Chip agreed to be auctioneer again, with Tim G. and Nicholas acting as assistants. Ken and Robbie will track bids and process payments. Need members at 6pm to help bring items upstairs. Tim G. will contact Red Cross to make sure we have access by 6pm. It was request that we have some “good” tags on the auction items. Ken will bring “postit” notes for this purpose. There will be an area to place donation items and a separate area to setup items that members wish to auction off.
- 7.) Elections Committee Chairperson Report** – Greg – W6ATB – has a tentative list that includes nominees for President, VP, Secretary, Treasure and one Director at Large. He is still exploring options for Membership, Technical, Activities, Publicity and a 2nd Director at Large.
- 8.) Visit to USS Iowa** – NI6BB - radio room. A plan is in the works to visit the radio room and tour the USS Iowa docked in San Pedro on Saturday, January 10th, 2015. It is hoped that we can also include some time operating the ham equipment in the room. Doug is in contact with the amateur who manages the room with the idea in mind that there will be operating slots available for club members. At the last General Meeting nine members and/or spouses indicated interest in attending.

New Business

- 1.) Club activates.** – Holiday Banquet at Marie Callendars – Anaheim Hills is on December 12th. A motion was made and seconded to budget \$1000 for prizes. The motion passed. The board is looking for assistance in putting together the traditional “spouse” baskets. It was suggest that “Beverly” would be approached to see if she is interested. Paul will be purchasing the prizes and also accepting any donated items.

Good of the Club

Adjourned at 9:44 am
Respectfully submitted by:
Tim Millard N6TMT, Secretary 2014.

OCARC Board Meeting Minutes for: November 8, 2014

The OCARC Board meeting was held at the JägerHaus Restaurant, 2525 East Ball Road, Anaheim, and called to order by President Nicholas AF6CF on Saturday, November 8, 2014 at 8:15 am. All directors except Treasurer – Ken – W6HHC, Membership – Doug – W6FKX, Technical – Bob – AF6C, Director at Large – Greg – W6ATB were in attendance.

DIRECTOR REPORTS

Pres – no report

VP – no report

Sec. – dues check from new member Bill Frey received in mail. Renewals for 2015 from WB9YCJ – Ken Diaz and W6GMU – Paul Gussow.

Activities – no report from Paul, however, the USS Iowa radio room visit has been arranged by Doug – W6FKX for January, 10th. Details will be published in the next two newsletters and announced at club meetings.

Pub. – Robbie – will be checking on the status of club information sheets at HRO.

Director at Large – Tom – W6ETC made it clear that he is available to assist with web site changes. Also, working with Disaster Resources United group which recently received 9 donated HT's. Unfortunately, 6 of the HT's will not transmit. Is wondering about assistance in getting them fixed at a low cost.

Old Business:

9.) Newsletter Editors: Dec-W6HHC, Jan-N6TMT, Feb-W6FKX

10.) General Meeting Entertainment, November – Dennis Kidder – W6DQ – “History of Receivers – Part 2, December 12th Christmas Party, Tim G. is working on a speaker for January and February meetings.

11.) FD 2014: Chairpersons and Doc status report. – No “whisper numbers” have been revealed, but should know something any day now when the December issue of QST is released.

12.) Online Interactive Membership Form. – Updates for PHP5 and testing were completed. We have at least one new member that utilized the form on November 6th. An email has been sent to him asking what he thought of the process.

13.) 2015 Field Day Site Selection – FD 2015 is June 27th and 28th. Tim G. spoke with Carla at School District office and she already has us on the schedule for 2015. Trash guidelines for 2015 is to follow “leave no trace” best practices and appoint a member to oversee that function during Field Day.

14.) Board Monthly Planner Document –Bob emailed out a copy of the document and there are no further changes.

15.) Elections Committee Chairperson Report – Greg – W6ATB – had a tentative list that includes nominees for President, VP, Secretary, Treasure and one Director at Large. Since Greg was unable to attend board meeting we do not have an updated status regarding further nominees.

16.) Holiday Banquet Preparations and prize soliciting – Per member cost will be \$29, this includes a choice of 1 out of 3 main dishes, Caesar salad, cornbread, either a fountain drink – ice tea or coffee, a 1 slice of pie from the following choices – Apple, Chocolate Cream, or

Lemon Meringue. Also, 1 door prize ticket. Enough door prizes will be on hand that everyone will walk away with a minor prize, also one lucky attendee will receive the premier prize - a \$500 gift certificate. Additionally, all female guest will receive an appreciation prize involving flowers and dark chocolate.

17.) Other Activity between now and the X-Mas party – no report.

New Business

2.) December Board meeting. –approved to not conduct a December Board meeting.

3.) Treasurer's end of year financial projection. – Treasurer was unable to attend today, so no report.

4.) Good of the Club Award – Nicholas is looking for members to email him for suggestions as he considers this annual award.

5.) Appoint Financial Audit Committee – The board is requesting that the following members make themselves available to sit down with the current treasurer and conduit an audit covering 2014. – Greg – W6ATB, Tom – W6ETC, and Bob – AF6C.

Good of the Club

- Tim – N6GP has not been able to get through to the FT4TA Tromelin Island DXpedition.
- Tom – W6ETC wants to bring up the usage of a commercial repeater on Saddleback as a club resource. We are hoping that he can organize a club meeting presentation on the benefits of this option.
- Also, the idea of organizing a club Ham Meshnet. See Wikipedia article for an overview of the concept - http://en.wikipedia.org/wiki/Mesh_networking

Adjourned at 9:45 am

Respectfully submitted by:

Tim Millard N6TMT, Secretary 2014.

OCARC Cash Flow - Year To Date

1/1/2014 through 11/5/2014

11/5/2014

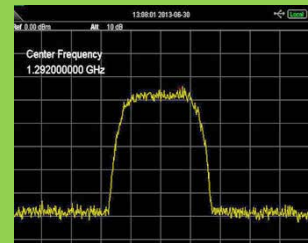
Page 1

Category	1/1/2014- 11/5/2014
INFLOWS	
ARRL Membership Income	78.00
Auction In	1,796.00
Badge Income	42.50
BADGE MAILING	2.50
Coffee Mug Sales	60.00
Donation - Bob WB6IXN	50.00
Donations - FD Food	950.00
Donations - Scoutarama	250.00
Dues, Family	280.00
Dues, Future	170.00
Dues, Membership	1,235.00
Opportunity Drawing -Monthly	471.00
Radio Sales Receipt	100.00
Reservation Deposit Refund	200.00
TOTAL INFLOWS	5,685.00
OUTFLOWS	
ARRL Membership Expense	61.00
Auction Expense	11.31
Auction Payout	1,110.15
BSA - OC	257.50
CA Statement Of Info filing	20.00
Coffee Mug Expense	80.00
Field Day - Flowers	64.80
Field Day - Generator Costs	46.00
Field Day Equipment	39.48
Field Day Food	994.74
Opportunity Drawing - Monthly	1,008.99
PO Box Rental	77.00
Printing - Club Brochures	482.84
Printing - membership Forms	110.38
Supplies	15.77
Web Site Hosting	179.88
TOTAL OUTFLOWS	4,559.84
OVERALL TOTAL	1,125.16



Digital Amateur TeleVision Exciter/Transmitter

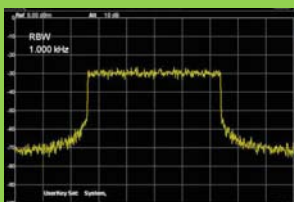
now available from



DATV-Express



- A more affordable DATV exciter can now be ordered
- Fully assembled and tested PCBA
- DVB-S protocol for DATV (using QPSK modulation)
- Can operate all ham bands from 70 MHz-to-2450 MHz
- RF output level up to 10 dBm (min) all bands (DVB-S)
- Software Defined Radio (SDR) architecture allows many variations of IQ modulations
- “Software-Defined” allows new features to be added over the next few years, without changing the hardware board
- As extra bonus, the team has been able to get the board to transmit DVB-T 2K mode, however we cannot guarantee the performance of that protocol. Caveat Emptor!
- Requires PC running Ubuntu linux (see User Guide)
- Price is US\$300 + shipping – order using PayPal



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